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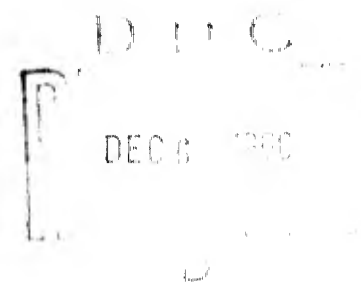
USATECOM PROJECT NO 8-6-6010-01

SERVICE TEST OF BOOT, COMBAT,
TROPICAL, DMS WITH SPIKE RESISTANT SOLE SHIELD

FINAL REPORT

by
MSG Columbus Sims, Jr.

August 1966



UNITED STATES ARMY TROPIC TEST CENTER

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APPROVED:

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UNITED STATES ARMY TROPIC TEST CENTER
Fort Clayton, Canal Zone

ABSTRACT

The Boot, Combat, Tropical, Direct Molded Sole with Spike Resistant Sole Shield, was service tested by the US Army Tropic Test Center in the Canal Zone during the period 21 February thru 21 June 1966. The test sample consisted of 85 pairs of boots. The boots were worn by personnel from airborne, mechanized, and regular infantry battalions, special forces units, and by field cadre at the US Army School of the Americas and the US Air Force Tropic Survival School. Use included local unit training and field exercises. (Test of protection against spikes was conducted by the US Army General Equipment Test Activity at Fort Lee, Virginia, and was not a part of the tropic test.) The test boot was found to be functionally suitable for field and garrison wear in the warm wet climate. The bonding of the rubber sole and heel and the ventilation and drainage eyelets are satisfactory to withstand at least 121 days use under rugged field conditions. Cracks developed in the center cleat-sole junction of the rubber sole on five pairs of boots during normal use. Seven failures were noted in the bonding of the rubber heel to the outsole. It was recommended that the Boot, Combat, Tropical, DMS with Spike Resistant Sole Shield, be considered suitable for Army use when shortcomings are corrected.

FOREWORD

This document reports the results of the service test of the Boot, Combat, Tropical, DMS with Spike Resistant Sole Shield, conducted by the US Army Tropic Test Center under tropic environmental conditions. Testing was directed by US Army Test and Evaluation Command under USATECOM Project No 8-6-6010-01.

US Army Tropic Test Center was responsible for preparing the test plan, test execution and preparing the test report.

The author gratefully acknowledges the personnel support provided by the Jungle Operations Committee, US Army School of the Americas; 8th Special Forces Group (Airborne); 3d Battalion (Airborne), 508th Infantry; 4th Battalion, 10th Infantry; 4th Battalion (Mechanized), 20th Infantry; and US Air Force Tropic Survival School (Cadre).

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SECTION 1. INTRODUCTION

1.1 BACKGROUND

Hostile troops include in their guerrilla tactics the use of sharp spikes of metal or bamboo, strategically placed on the ground or under water in such a manner that they can penetrate the outsoles of conventional footwear and cause numerous foot injuries.

The Office of the Quartermaster General directed that efforts be made to counteract such tactics. Research in response to this directive, begun in October 1961, resulted in the development of a protective spike resistant insole (insert type) which was tested by the US Army Airborne, Electronics and Special Warfare Board under Project No. 1262, type classified Limited Production and procured in accordance with Limited Production Purchase Description 39-63.

US Army Natick Laboratories subsequently developed a Boot, Combat, Tropical, Direct Molded Sole with Sole Shield, Spike Resistant. This boot incorporated as an integral part a sole shield consisting of a series of overlapping stainless steel strips. Single strips of stainless steel protected the toe area (two inches) and the heel to shank area (four inches), with overlapping 3/4-inch strips protecting the rest of the plantar surface of the foot. Testing of this boot was accomplished in 1961 by the US Army General Equipment Test Activity and the US Army Infantry Board. These tests revealed shifting of the overlapping strips to the extent that the sole shield was rendered ineffective as a protective device.

In June 1964, US Army Combat Developments Command reported results of a detailed review of the need for protection of the plantar surface of the foot against spike devices. Fundamental among these results was a determination that for certain special warfare personnel operating in areas of actual or potential hazards a limited requirement exists for protection. Spike injuries in general and plantar-surface injuries in particular constitute a relatively small percentage of total battle casualties in the Republic of Vietnam. US Army Combat Developments Command stated that 60% of wounds from spike devices in the Republic of Vietnam have been incurred above the foot. US Army Combat Developments Command recommended that foot protection be provided on an "as required" basis, using an improved slip insole.

On 2 November 1964, US Army Test and Evaluation Command directed the US Army Tropic Test Center to conduct a service test

of the Spike Resistant Insole. As a result of actions to correct deficiencies reported in this test and others, a new boot was designed for test.

On 26 November 1965, US Army Tropic Test Center was directed to conduct a service test of the new Boot, Combat, Tropical, DMS with Spike Resistant Sole Shield. The test was conducted from 21 February to 21 June 1966. Concurrent with this test, the US Army General Equipment Test Activity conducted an engineering test.

1.2 DESCRIPTION OF MATERIEL

The test item is the Boot, Combat, Tropical, DMS with a solid steel plate built into the midsole. This plate is made of .011 inch gauge stainless steel. The boot has a cleated sole and heel vulcanized and molded directly to the leather upper. The outsole is made from two "biscuits" of uncured rubber, one "biscuit" forming the entire tread surface of the outsole and one "biscuit" forming the tread surface of the heel. Vulcanization under pressure cures or "knits" the two biscuits into a one-piece sole and heel while simultaneously bonding sole and heel directly to the upper. The boot upper is composed of leather vamp, leather counter, leather eyelet stay and nylon/cotton top facing, quarters and gusset. The boot has a cloth vamp lining with a polystyrene box toe between the lining and the leather vamp. The gusset is attached all the way to the top of the boot to prevent entry of leeches, etc., when the wearer is wading through swampy areas. The quarters and gusset are treated with a copper-8-quinolinolate to impart mildew resistance to the cotton. Brass eyelets are positioned in the rear of the inside ball area of the leather vamp to provide ventilation and to allow water to drain from the boot (see Figure 1, Appendix V).

The term "bonding failure" is used to denote failure of the rubber material to adhere to the leather material with resultant separation of the outsole from boot upper.

The term "knitting failure" is used to denote failure of the two biscuits of identical rubber compound to cohere with resultant separation of heel from sole material or degradation of heel material.

1.3 OBJECTIVE

To determine the suitability of the test item for use by US Army personnel in the humid tropics with particular attention to

comfort, mobility and durability. (Test objective does not include determination of the boot's resistance to spike penetration.)

1.4 SUMMARY OF RESULTS

a. The test boot met requirements for garrison and field use under warm-wet climatic conditions with respect to comfort, foot and ankle support, ease of donning and doffing, adequacy of closure, and drying characteristics.

b. The test boot was very acceptable to the soldier in the tropics and was preferred for jungle wear over the standard, all-leather, combat boot and the old jungle boot with buckle top.

c. The boot afforded the wearer adequate protection from underbrush, insects and other objects normally encountered when walking through the jungle. There are no leeches in the Canal Zone. No penetration of the boot sole by sharp wooden or metal spikes occurred during normal use.

d. No chafing or blistering of the foot was caused by the spike resistant sole shield.

e. The test boot was compatible with the field uniform and presented a satisfactory appearance; however, the top of the boot is too short to allow blousing of the trousers inside the top of the boot.

f. The cloth quarters became stained from jungle wear and shoe polish. No adverse functional effects were observed as a result. Ease of maintenance would be improved if the cloth were black.

g. Satisfactory traction was provided by the cleated sole, but traction was diminished somewhat by mud and small rocks sticking between the sole cleats.

h. No failures were observed in the bonding of the rubber sole to the leather upper. However, failures in the bonding of the rubber heel to the outsole were observed in seven pairs of the boots. This is a shortcoming.

i. Two ventilation and drainage eyelets became dislodged during the test period. This is a shortcoming.

j. The boot was found to be sufficiently durable for at least 121 days of wear in a warm-wet environment.

k. On one boot the top of the cloth gusset, beneath the edging tape, was torn from pulling on the gusset while donning the boot. This is a shortcoming.

l. On five pairs of boots, cracks developed in the rubber sole at the intersection of the middle cleats and front end of the steel shank. This is a shortcoming.

m. The edge of the saran insole frayed after two to three months of use, causing some discomfort to the wearer. This is a shortcoming.

1.5 CONCLUSIONS

The Boot, Combat, Tropical, DMS with Spike Resistant Sole Shield, is suitable for Army use in warm-wet climatic conditions for periods of wear of 121 days. The boots will probably remain serviceable for periods of wear much longer than 121 days, but the expected life of the boots was not determined by this test.

1.6 RECOMMENDATIONS

a. That the Boot, Combat, Tropical, DMS with Spike Resistant Sole Shield, be considered suitable for Army use when the shortcomings listed in Appendix III are corrected.

b. That the cloth quarters of the boot be colored black.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

2.1.1 Test Sample

Ninety pairs of test boots (Figure 1, Appendix V), less five pairs withdrawn for orientation use by Tropic Test Center, were issued to selected groups of test personnel in US Army units on duty in the Canal Zone.

2.1.2 Test Procedure

Test participants subjected the test item to maximum wear conditions by use in normal operations, both in the jungle and in the tropical savanna areas existing in the Canal Zone and Rio Hato, Republic of Panama, respectively. The following distribution of test boots was made.

<u>Unit</u>	<u>Number of Pairs Assigned</u>
US Air Force Tropic Survival School (Cadre)	11
Jungle Operations Committee, US Army School of the Americas (Cadre)	16
8th Special Forces Group (Airborne)	9
3d Battalion (Airborne), 508th Infantry	16
4th Battalion, 10th Infantry	16
4th Battalion (Mechanized), 20th Infantry	17

Each supporting unit designated a unit project officer and a test recorder to assist in control and supervision of the test in his respective unit.

The wear test extended over a period of approximately four months.

Five pairs of boots were withdrawn after each 30 days of wear and examined by the engineering test agency (US Army General Equipment Test Activity).

2.1.3 Test Data

The service test utilized the results obtained from normal wear by test participants in field and garrison operations in a natural, humid, tropical environment to determine the suitability and durability of the boots. Test data were gathered from interviews, direct observation and subjective opinions solicited from test participants on questionnaires. Questionnaires were administered upon withdrawal of boots from the test, after two months of wear and at the end of the test period. Five of the original 85 pairs issued were withdrawn from the test for various reasons, such as nonavailability of test participants over the entire test period due to transfer to Vietnam and CONUS. The use of six test groups engaged in a variety of missions insured rigorous testing in a variety of different operations and conditions not possible with one group.

Visual inspection for any defects that might alter test results was made of all test boots prior to issue.

All boots were code-marked with Arabic numerals from 1 thru 90 for identification and future reference in case of failures.

Each test participant had five or more months expected retainability in his unit.

Each test participant was individually fitted with a pair of precoded test boots by a qualified fitter, using a calibrated foot-measuring device. Each test participant was issued a properly-fitted new pair of standard cushion-sole socks to be worn during the initial fitting.

The fitting of the test boots was considered correct based upon the opinions of the fitting technician and the test participant. The ease of fitting the test boot to participants and any evidence of improper sizing (labeled versus actual) were noted. Only test participants with correctly fitted boots were used in the test.

Ambient weather data, to include daily extremes of temperature, relative humidity and precipitation in the Canal Zone, were recorded during the test period on each side of the Isthmus (Charts 1 and 2, Appendix I).

Still pictures were used, when appropriate, to supplement other data obtained during the test.

2.1.4 Safety

Developer Safety Statement: Research, development and testing to date have demonstrated nothing to contraindicate wear or use of subject item by test personnel from a safety standpoint.

2.1.5 Control Item

No control items were used in the conduct of this test; however, test participants were asked to relate their appraisal of the test boot to the type of combat boot which they ordinarily would be wearing.

2.2 SUBTEST NO 1 - SUITABILITY AND COMFORT

2.2.1 Objectives

a. To determine whether the test boot was functionally suitable for use in a variety of occupational duties, both in the field and in garrison, under warm-wet climatic conditions.

b. To determine the effects of the sole shield on the comfort of the individual.

2.2.2 Method

Test participants were instructed in the objective of the service test and were requested to wear the test boots continually while they were in the field participating in all activities associated with range firing, unit training, field exercises, parachute jumps and Army Training Tests and while in garrison performing regular duties. The test boot was not worn on an alternate basis with any other type combat boot except for health reasons, as directed by a medical officer, or in instances where the test boot had become thoroughly wet and was being allowed to dry.

The effect of the boot on the mobility of the wearer, when used to traverse terrain features, was determined to include stability and traction afforded the wearer and restrictions of the boot on movement.

At the conclusion of the first two-month wearing test period and at the conclusion of the test wear period, each test participant answered a questionnaire to provide subjective data and to express his opinion with respect to each of the following

characteristics of the test boot. (Because of the close similarity in responses, only the test end questionnaires were used for the statistical data in Appendix 1.)

- a. Suitability of fit at beginning and end of the wearing test period.
- b. Comfort, with emphasis on chafing of the foot caused by the spike resistant sole shield.
- c. Foot and ankle support.
- d. Protection afforded to the wearer from underbrush, insects and sharp objects.
- e. Ease of donning and doffing.
- f. Adequacy of closure.
- g. Compatibility with field uniform.
- h. Appearance.
- i. Traction provided by cleated sole and heel under various conditions and other characteristics which affect the mobility of the wearer.
- j. Self-cleaning ability of sole and heel cleats.
- k. Drying characteristics.
- l. Ability to drain water.
- m. Durability, with particular attention to adequacy of the bond and knit of the sole and heel.
- n. Overall troop acceptability.

Each test participant was asked to state a preference for either the test boot or the standard combat boot for Army use in a warm-wet climate.

2.2.3 Results

No evidence of improper sizing (labeled versus actual) was noted when fitting the boots. The test participants' responses on

suitability of the boots covered in paragraph 2.2.2a-n are shown in Tables 1-8, Appendix I.

Test participants stated that the boots dried in from one and one-half to eight hours, with an average time of three hours, under field conditions after being completely wetted.

2.2.4 Analysis

The test boots are sized properly. Three test participants stated that they would have preferred a one or one-half size smaller than they were issued.

A small number of test participants stated that the boots expanded a little during wear and became loose on their feet. This observation is not considered unusual in the wear of footwear in the tropical environment where the boot is wet both by immersion and by perspiration daily. The looseness can be compensated in most cases by wearing heavier socks.

Two test participants stated that the overlap of the gusset causes lumpy areas which press on the ankle, causing a slight discomfort.

The test boots are comfortable for wear, and no significant chafing or blistering of the feet or other discomfort is caused by the solid steel plate built into the midsole.

The foot and ankle support provided by the test boot is adequate for normal field wear. The boots can be worn safely while performing parachute jumps even though not as much foot and ankle support is provided by the test boots as is provided by the standard, all-leather, combat boot.

The boot provides adequate protection against insects, underbrush and other objects normally encountered while moving through the jungle. Protection against leeches could not be determined due to the absence of leeches in the Canal Zone. Several test participants remarked that the canvas sides of the boots were penetrated by sharp spines, such as those on the Black Palm, or thorny bushes in the jungle. However, no serious injuries were sustained. No penetration of the sole was noted or reported during the test period.

The boots are easily donned and doffed, and the closure of the boot is adequate.

In its present form, the test boot is compatible with the field uniform; however, many of the test participants stated that a boot top one to two inches higher or trousers made one to two inches longer is more desirable because they could then blouse their trousers easier and present a more military appearance.

The appearance of the test boot is satisfactory; however, the green cloth quarters become stained after field use and it is difficult to keep shoe polish from streaking areas of the cloth immediately adjacent to the leather upper when applying black boot polish. A few test participants dyed the green upper with black leather dye to conform more with other personnel wearing standard, all-leather, combat boots in garrison. The dyeing of the cloth did not appear to have any adverse effects on the comfort of the boot. The leather surface can be easily polished with most brands of wax shoe polish.

The traction provided by the cleats on the test boot in normal field use in the jungle and other terrain found in the tropical environment is satisfactory, but traction is diminished somewhat by silty mud and wet clay clinging between the cleats. Mud and clay cling to the soles and cleats when wet, but fall off when dry. Small rocks lodge between the cleats and must be extracted by pushing with a stick or small tool (Figure 2, Appendix V). The present cleat pattern and spacing at the ground contact surface is considered satisfactory for traction and weight distribution, but the self-cleaning characteristic of the cleats should be improved.

The drying characteristics of the boot are satisfactory, both while being worn and when off the feet. Water will drain from the drainage and ventilation eyelets unless they are plugged with mud or other foreign matter. The drainage vents usually can be easily unplugged by flushing with water. Wetting and drying did not adversely affect the leather of the boots, but the cloth upper showed signs of fading.

The test boot is very acceptable to US Army and Air Force personnel and much preferred for use in the tropics over the standard all-leather boot or the old jungle boot with buckle top.

2.3 SUBTEST NO 2 - DURABILITY

2.3.1 Objective

To determine the overall durability of the test boot when worn for extended periods under warm-wet climatic conditions with

emphasis on detection of bonding and knitting failures of the out-sole and separation of the modified eyelet from the test boot.

2.3.2 Method

Throughout the wearing test period, supervisory test personnel monitored the performance of the test boots, paying particular attention to any failure of the bond of the sole and the leather upper, separation of the heel from the sole, separation of eyelets from the boot, uneven wear of the heel and sole, seam separation, shifting, fracturing or any other action of the sole shield to determine if there was any evidence of lack of durability.

The test participants were requested to report immediately to the unit project officer any sign of failure of the bond of the sole to the leather upper, any separation of the heel from the sole or any other major failure of the test boot.

2.3.3 Results

No failures were observed in the bond of the rubber sole to the leather upper; however, seven failures were observed in the bonding of the heel to the leather upper (Figure 3, Appendix V). This is a shortcoming.

Ventilation and drainage eyelets separated from two different boots during the test (Figure 4, Appendix V).

The amount of surface worn off the cleats during the test period was very minor. In general, more wear occurred on the heel and toes than in other parts of the sole. The amount and location of wear points varied with the individual.

The top of the gusset on one pair of boots was ripped. In this case, the cloth failed at the edging tape when the gusset was pulled during donning action, and a two-inch tear resulted (Figure 5, Appendix V).

No lacing eyelets pulled out of the boots during the test.

At the end of the test period, five of the eighty pairs of test boots showed cracking of the sole (Figure 6, Appendix V). The cracks occurred only at the cleat-sole junction of the large center cleat and front end of the shank. No cracks were observed in the heel area.

Approximately 30% of the saran insoles showed signs of abrasive wear at areas in contact with the ball and heel of the boot. Very little fraying was noted along the bonded edge of the insole.

2.3.4 Analysis

Seventy-five of the 80 pairs of boots were serviceable at the end of 121 test days (101 average wear period).

The sole cracks noted in paragraph 2.3.3 appeared to be caused by the normal flexing of the sole during wear of the boot. The cracks behind the main cleat are apparently due to the high stress at this point caused by the end of the steel plate (shank) in the last. The exact time when the boot soles began cracking is undetermined; however, no difficulties were encountered by the test participants while wearing the boots with these cracks. The failure appeared to be a failure of the rubber itself and not a failure in the knit or bond of the molded sole. This failure in the boot sole is considered a shortcoming.

The separation of the bonding of the heel to the leather upper seems to be caused by frequent wetting and drying. It appears correctable by using an improved adhesive and forming the entire tread surface around the heel. This failure in the boot heel bonding is considered a shortcoming.

The fraying of the saran insole did not decrease its usability, but the frayed ends of the fibers do cause some discomfort. The tendency of the edge of the insole to fray is considered a shortcoming and should be eliminated, if possible.

SECTION 3, APPENDICES

- I. TEST DATA
- II. FINDINGS
- III. DEFICIENCIES AND SHORTCOMINGS
- IV. MAINTENANCE EVALUATION
- V. PHOTOGRAPHS
- VI. REFERENCES
- VII. DISTRIBUTION LIST

APPENDIX I, TEST DATA

TABLE 1
NUMBER AND SIZE OF BOOT TEST SAMPLE

WIDTHS	Sizes						TOTAL
	7	8	9	10	11	12	
N	-	-	8	8	4	2	22
R	2	5	22	13	3	2	47
W	3	8	7	3	-	-	21
TOTALS	5	13	37	22	7	4	90

TABLE 2

WEAR OF TEST BOOTS

Unit	Number of Pairs of Boots			Number of Days of Wear Per Individual		
	Original Issue	Withdrawn from Test	Finished Test	Maximum	Minimum	Weighted Average
3d Bn (Abn), 508th Inf	16	2	14	120	60	85
4th Bn (Mech), 20th Inf	17	0	17	120	15	113
4th Bn, 10th Inf	16	3	13	120	70	114
8th Special Forces Gp (Abn)	9	0	9	100	40	75
AF Tropic Survival School	11	0	11	121	50	102
Jungle Operations Committee, USA School of the Americas	16	0	16	121	50	106
TOTAL	85	5	80	OVERALL WEIGHTED AVG: 101		

TABLE 3
TEST PARTICIPANTS' OPINION OF FIT
OF TEST BOOT AT BEGINNING AND END OF TEST
(80 Test Participants)

Unit	At Beginning of Test		At End of Test	
	Good	Bad	Good	Bad
3d Bn (Abn), 508th Inf	14	0	14	0
4th Bn (Mech), 20th Inf	17	0	17	0
4th Bn, 10th Inf	13	0	13	0
8th Special Forces Gp (Abn)	8	1	9	0
AF Tropic Survival School	11	0	11	0
Jungle Operations Committee, USA School of the Americas	14	2	16	0
TOTAL	77	3	80	0
PERCENTAGE	96.25	3.75	100	0

TABLE 4

TEST PARTICIPANTS' ANSWERS TO QUESTIONS ON
COMFORT, CHAFING AND FOOT AND ANKLE SUPPORT

(80 Test Participants)

Unit	Comfortable		Chafing or Blistering		Adequate Foot and Ankle Support			
					Regular Duty		Parachute Jumps	
	Yes	No	Yes	No	Yes	No	Yes	No
3d Bn (Abn), 508th Inf	13	1	0	14	12	2	12	2
4th Bn (Mech), 20th Inf	16	1	0	17	17	0	NA	NA
4th Bn, 10th Inf	12	1	1	12	13	0	NA	NA
8th Special Forces Group (Abn)	7	2	0	9	9	0	9	0
AF Tropic Survival School	11	0	0	11	11	0	NA	NA
Jungle Operations Committee, USA School of the Americas	13	3	4	12	16	0	NA	NA
TOTAL	72	8	5	75	78	2	21	2
PERCENTAGE	90	10	6.25	93.75	97.5	2.5	91.3	8.7

TABLE 5

TEST PARTICIPANTS' ANSWERS TO QUESTIONS ON
SENSE OF COOLNESS AND VENTILATION, ADEQUATE PROTECTION AND EASE OF DONNING AND DOFFING
(80 Test Participants)

Unit	Sense Coolness and Ventilation		Adequate Protection from Underbrush		Ease of			
	Yes	No	Yes	No	Donning Yes	Donning No	Doffing Yes	Doffing No
3d Bn (Abn), 508th Inf	13	1	13	1	14	0	14	0
4th Bn (Mech), 20th Inf	16	1	13	4	17	0	17	0
4th Bn, 10th Inf	13	0	13	0	13	0	13	0
8th Special Forces Group (Abn)	8	1	6	3	9	0	9	0
AF Tropic Survival School	11	0	11	0	11	0	11	0
Jungle Operations Committee, USA School of the Americas	15	1	15	1	16	0	16	0
TOTAL	76	4	71	9	80	0	80	0
PERCENTAGE	95	5	88.75	11.25	100	0	100	0

TABLE 6

TEST PARTICIPANTS' ANSWERS TO QUESTIONS ON
CLOSURE, BLOUSING OF TROUSERS, APPEARANCE AND TRACTION

(80 Test Participants)

Unit	Adequate Closure		Easy Blousing of Trousers		Desirable Appearance		Adequate Traction	
	Yes	No	Yes	No	Yes	No	Yes	No
3d Bn (Abn), 508th Inf	13	1	9	5	14	0	13	1
4th Bn (Mech), 20th Inf	15	2	8	9	15	2	16	1
4th Bn, 10th Inf	13	0	10	3	13	0	13	0
8th Special Forces Group (Abn)	9	0	4	5	9	0	9	0
AF Tropic Survival School	11	0	9	2	11	0	11	0
Jungle Operations Committee, USA School of the Americas	16	0	14	2	16	0	11	5
TOTAL	77	3	54	26	78	2	73	7
PERCENTAGE	96.25	3.75	67.5	32.5	97.5	2.5	91.25	8.75

TABLE 7

TEST PARTICIPANTS' ANSWERS TO QUESTIONS ON FLEXIBILITY, SELF-CLEANING ABILITY, ADVERSE EFFECTS OF REPETITIVE WETTING AND DRYING, AND ABILITY TO DRAIN WATER

(80 Test Participants)

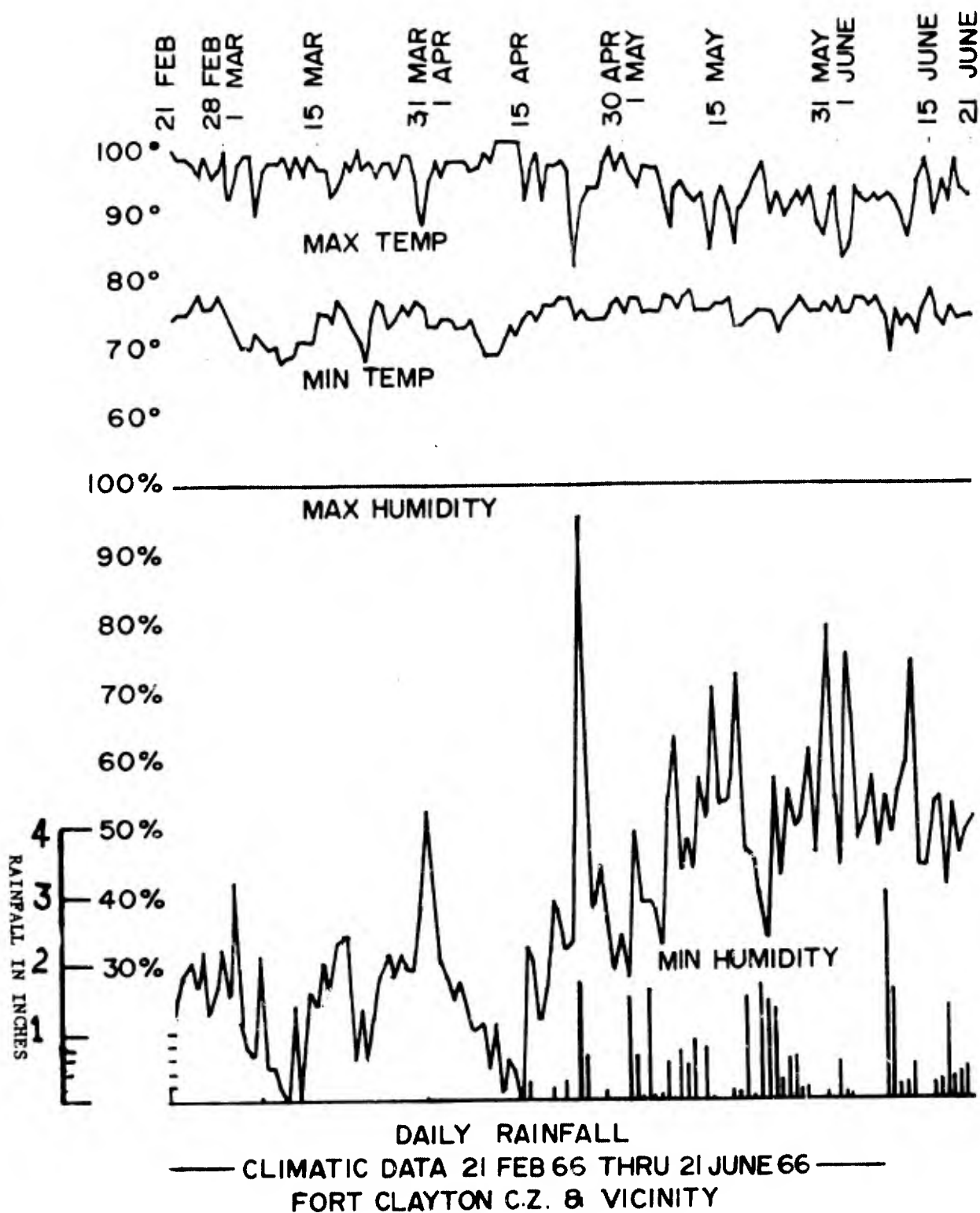
Unit	Flexibility		Cleats Self-Cleaning		Adverse Effects of Wetting and Drying		Drain Water	
	Yes	No	Yes	No	Yes	No	Yes	No
3d Bn (Abn), 508th Inf	14	0	10	4	0	14	14	0
4th Bn (Mech), 20th Inf	17	0	10	7	2	15	17	0
4th Bn, 10th Inf	13	0	8	5	1	12	13	0
8th Special Forces Group (Abn)	8	1	5	4	1	8	9	0
AF Tropic Survival School	11	0	8	3	1	10	11	0
Jungle Operations Committee, USA School of the Americas	16	0	4	12	2	14	16	0
TOTAL	79	1	45	35	7	73	80	0
PERCENTAGE	98.75	1.25	56.25	43.75	8.75	91.25	100	0

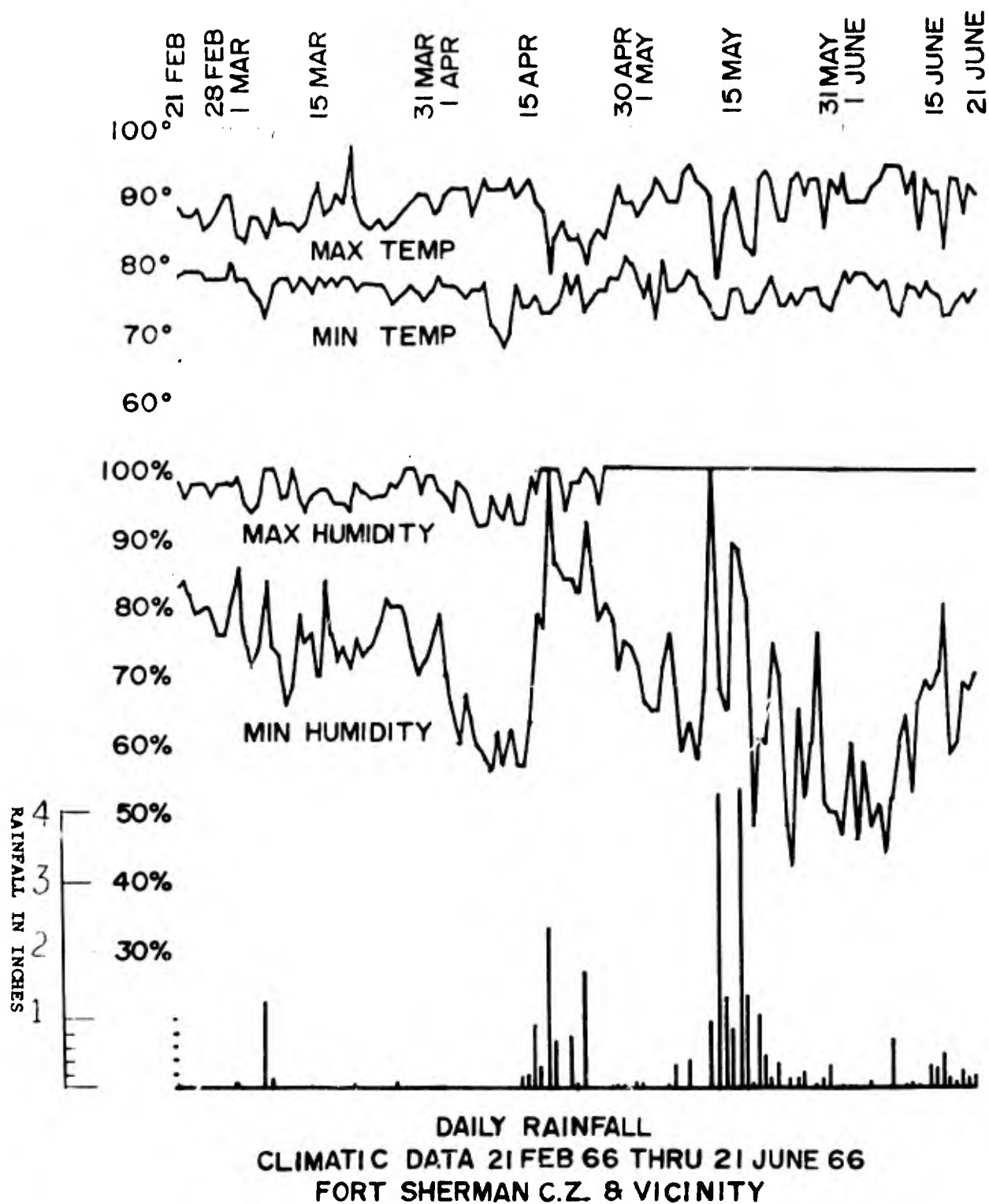
TABLE 8

TEST PARTICIPANTS' RATING FOR ACCEPTABILITY FOR THE TEST BOOT AND
PREFERENCE FOR TEST BOOT, STANDARD ALL-LEATHER COMBAT BOOT, OR JUNGLE BOOT W/BUCKLE TOP

(80 Test Participants)

Unit	Rating of Test Boot								Preference For		
	Extremely Acceptable	Very Acceptable	Acceptably Acceptable	Moderately Acceptable	Just Acceptable	Slightly Unacceptable	Very Unacceptable	Extremely Unacceptable	Test Boot	Standard All-Leather Combat Boot	Jungle Boot w/Buckle Top
4th Bn (Mech), 20th Inf	13	3	-	1	-	-	-	-	15	0	2
3d Bn (Abn), 508th Inf	8	4	1	1	-	-	-	-	12	0	2
8th Special Forces Gp (Abn)	7	2	-	-	-	-	-	-	9	0	0
4th Bn, 10th Inf	6	7	-	-	-	-	-	-	13	0	0
AF Tropic Survival School	9	2	-	-	-	-	-	-	11	0	0
Jungle Operations Committee, USA School of the Americas	10	5	1	-	-	-	-	-	15	0	1
TOTAL	53	23	2	2	-	-	-	-	75	0	5
PERCENTAGE	66.3	28.7	2.5	2.5	-	-	-	-	93.75	0	6.25





APPENDIX II. FINDINGS

Requirement	Complied with Requirement	Remarks
1. The boots shall produce no physical effects to the feet of the wearer attributable to the steel plate.	Yes	See paragraph 2.2.4.
2. The boots shall be functionally suitable for garrison and field use under warm-wet climatic conditions with respect to comfort, foot and ankle support provided, ease of donning and doffing, adequacy of closure and drying characteristics, and protection afforded from underbrush, insects and other objects normally encountered when walking through the jungle.	Yes	See paragraph 2.2.4.
3. The boots shall be durable when worn for extended periods under warm-wet climatic conditions.	Partially	See paragraph 2.3.3.

APPENDIX III. DEFICIENCIES AND SHORTCOMINGS

1. DEFICIENCIES		
<u>Deficiency</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
None	NA	NA
2. SHORTCOMINGS		
<u>Shortcoming</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
a. Cracks developed at the junction of the rear of the center cleats and front of the steel shank.	Unknown	Test participants were unaware when cracks developed. This failure occurred on five boots.
b. The bonding of the heel to the leather upper separated.	Improve adhesive and form the entire tread surface around the heel.	This failure occurred on seven boots.
c. The cloth adjacent to the edging tape at top of the gusset tore when participant was donning the boot.	Unknown	This failure occurred once during the test period.
d. The saran insole frayed on the edges and in the area of the ball and heel of the foot.	Unknown	This failure occurred in approximately 30% of the insoles.

APPENDIX IV. MAINTENANCE EVALUATION

Other than the normal polishing of the boot leather, the only maintenance required was cleaning the mud and rocks from between the cleats of the boot. This was accomplished with either a stick or small tool, and required only a minimal amount of time. Ease of maintenance would be enhanced by having the cloth portion of the boot colored black.

APPENDIX V. PHOTOGRAPHS

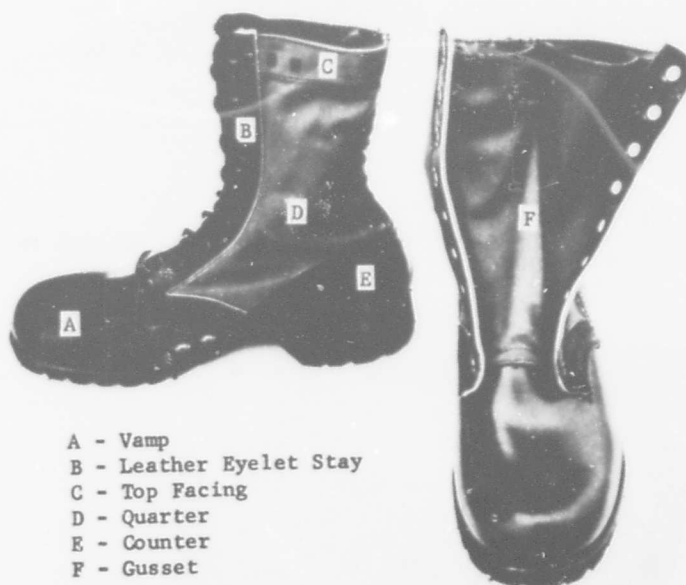


Figure 1. Front and side view of Boot, Combat, Tropical,
DMS with Spike Resistant Sole Shield.

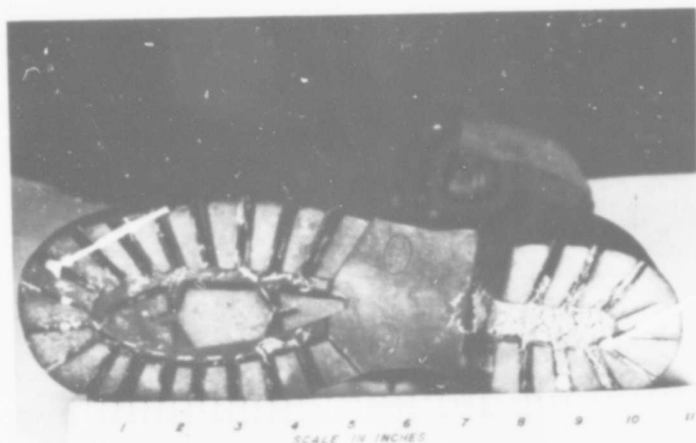


Figure 2. Rocks and mud lodged between cleats on heel and sole of test boot.

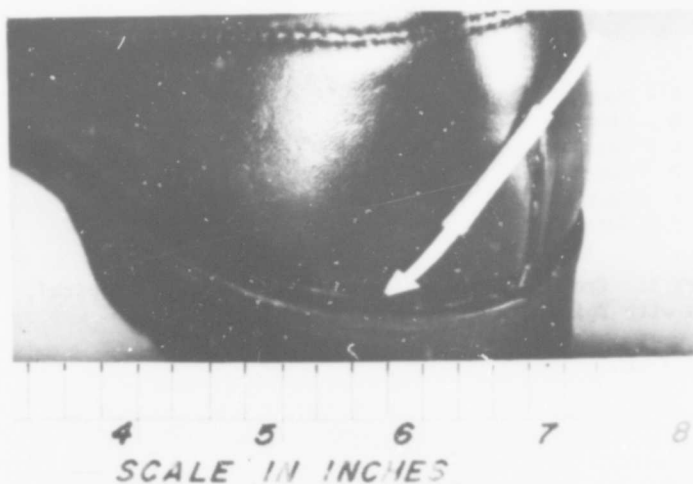


Figure 3. Bonding failure (separation of the heel from the upper).

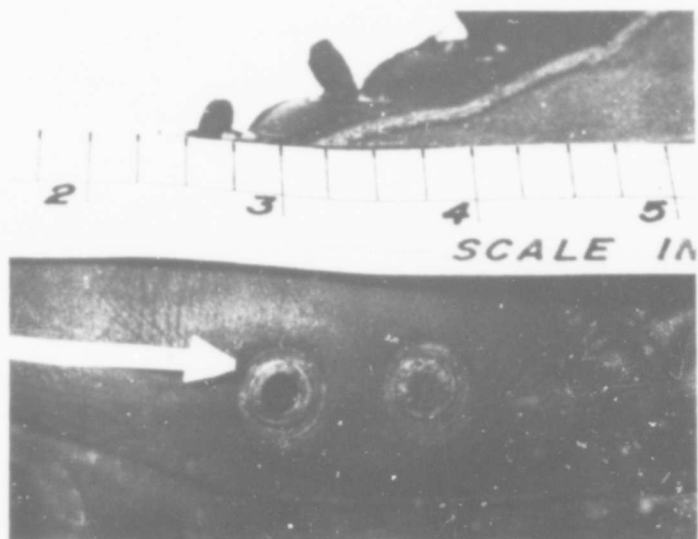


Figure 4. Dislodged ventilation and drainage eyelet.



Figure 5. Frayed gusset top with edging tape pulled off.

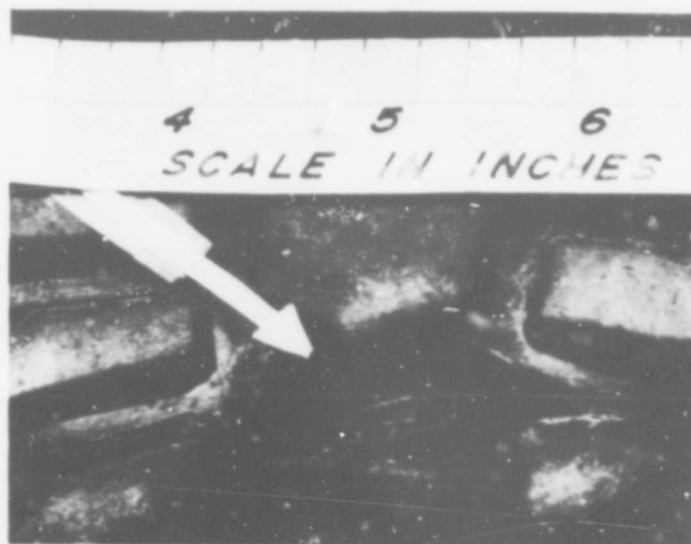


Figure 6. Cracking at cleat-sole junction.

APPENDIX VI. REFERENCES

1. RDT&E Project No 1M643303D547.
2. Letter, QMGRE-D, Office of the Quartermaster General, 17 October 1961, subject: Protection Against Foot Penetration Devices.
3. Report of USATECOM Project Nos. 8-3-6010-01K and 8-3-6010-02K, Integrated Engineering/Service Test of Boot, Combat, Tropical, DMS, with Sole Shield, Spike Resistant, US Army Infantry Board and US Army Quartermaster Research and Engineering-Field Evaluation Agency, January 1964.
4. Third Indorsement, AMCRD-DM-E (19 Sep 63), US Army Materiel Command, 7 July 1964, subject: Protection Against Foot Penetration Devices.
5. Letter, AMSTE-BC, US Army Test and Evaluation Command, 14 July 1964, subject: Test of Boot, Combat, Tropical, DMS with Sole Shield, Spike Resistant.
6. Letter, AMSTE-BC, US Army Test and Evaluation Command, 2 November 1964, subject: Test Directive, USATECOM Project No 8-5-6010-01, 8-5-6010-02, Engineering and Service Test of Spike Resistant Insole.
7. Letter, AMSTE-BC, US Army Test and Evaluation Command, 9 September 1965, subject: Final Report of Engineering Test and Service Test of Spike Resistant Insole.
8. Letter, AMXRE-COP, US Army Natick Laboratories, 7 October 1965, subject: Final Report of Engineering Test and Service Test of Spike Resistant Insole.
9. Discussion, Committee 8, USATECOM Desert/Tropic Test Planning Conference, 16 November 1965, subject: ET/ST of Boot, Combat, Tropical, DMS with Sole Shield, Spike Resistant.
10. Letter, AMSTE-BC, US Army Test and Evaluation Command, 26 November 1965, subject: Test Directive Engineering and Service Test of Boot, Combat, Tropical, DMS with Spike Resistant Sole Shield, USATECOM Project No 8-6-6010.
11. Plan of Service Test of Boot, Combat, Tropical, DMS with Spike Resistant Sole Shield, US Army Tropic Test Center, December 1965.

APPENDIX VII. DISTRIBUTION LIST

Distribution denoted by an asterisk (*) will be made from those copies forwarded to Headquarters, US Army Test and Evaluation Command.

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13 ABSTRACT		
<p>The Boot, Combat, Tropical, Direct Molded Sole with Spike Resistant Sole Shield, was service tested by the US Army Tropic Test Center in the Canal Zone during the period 21 February thru 21 June 1966. The test sample consisted of 85 pairs of boots. The boots were worn by personnel from airborne, mechanized, and regular infantry battalions, special forces units, and by field cadre at the US Army School of the Americas and the US Air Force Tropic Survival School. Use included local unit training and field exercises. (Test of protection against spikes was conducted by the US Army General Equipment Test Activity at Fort Lee, Virginia, and was not a part of the tropic test.) The test boot was found to be functionally suitable for field and garrison wear in the warm wet climate. The bonding of the rubber sole and heel and the ventilation and drainage eyelets are satisfactory to withstand at least 121 days use under rugged field conditions. Cracks developed in the center cleat-sole junction of the rubber sole on five pairs of boots during normal use. Seven failures were noted in the bonding of the rubber heel to the outsole. It was recommended that the Boot, Combat, Tropical, DMS with Spike Resistant Sole Shield, be considered suitable for Army use when shortcomings are corrected.</p>		

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Boot, Combat, Tropical, DMS with Spike Resistant Sole Shield Tropic Testing of Footwear						

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